ACCESSION #: 9608010025
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Prairie Island Nuclear Generating PAGE: 1 OF 9
Plant Unit 1

DOCKET NUMBER: 05000282

TITLE: Loss of Offsite Power to Unit 2 and Degraded Offsite
Power to Unit 1 Followed by Reactor Trips of Both Units
EVENT DATE: 06/30/96 LER #: 96-12-00 REPORT DATE: 7/29/96

OTHER FACILITIES INVOLVED: Prairie Island Unit 2 DOCKET NO: 05000306

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(i), 50.73(a)(2)(iii), 50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Jack Leveille TELEPHONE: (612) 388-1121

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On June 29, 1996, both Units 1 and 2 were operating at 100% power. In summary, both reactors tripped following the loss of three of four 345 KV offsite transmission lines to the plant substation, due to high winds. The plant safeguards busses were supplied power by the four safeguards diesel generators for several hours.

All safeguards diesel generators provided the needed electrical power throughout the duration of the event. In addition, all cooling water (essential service water) pumps functioned as required. The event was mitigated by the proper functioning of the safety related equipment and the proper management of the event by operators.

END OF ABSTRACT

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EVENT DESCRIPTION

On June 29, 1996, both Units 1 and 2 were operating at 100% power. In summary, both reactors tripped following the loss of three of four 345 KV offsite transmission lines to the plant substation. The plant safeguards busses were supplied power by the four safeguards diesel generators for several hours.

In the afternoon several isolated thunderstorms formed. At approximately 1418 the Blue Lake 345 KV line tripped and stayed out, from a single phase line to ground fault. At approximately 1429 both Red Rock 345 KV lines #1 and #2 tripped and stayed out, from a three phase fault. Towers on the Red Rock lines and the Blue Lake line are several miles from one another and about 10 miles north of the plant. The Prairie Island substation utilizes a ring bus with a breaker and a half configuration (see Figures 1 and 2). The electrical pre-event configuration was as follows:

PI Unit 1 Main Generator 1_/ connections:
Red Rock line #1
PI BUS 2_/ 345-1
PI Unit 2 Main Generator connections:
Blue Lake line until it was lost at 1418
PI Bus 345-1
PI Bus 345-1 connections:
Red Rock line #2
PI Unit #1 Main Generator
PI Unit #2 Main Generator
Offsite source 2R transformer 3_/
Offsite source CT-11 transformer via CT-1 transformer
PI Bus 345-2 connections:
Byron line
Blue Lake line, subsequently disconnected prior to event
Red Rock line #1
Offsite source 1R transformer via #10 transformer
Offsite source CT-12 transformer via #10 transformer
Safeguards Bus 4_/ 15 (Unit 1) source was 1R transformer (Path 1-1)
Safeguards Bus 16 (Unit 1) source was CT-11 transformer (Path 1-2)
Safeguards Bus 25 (Unit 2) source was 2R transformer (Path 2-1)
Safeguards Bus 26 (Unit 2) source was CT-12 transformer (Path 2-2)

Immediately following the loss of the Red Rock lines, the following electrical configuration existed:

1_/ EIIS System Identifier: EL; EIIS Component Identifier: GEN
2_/ EIIS Component Identifier: SSBU
3_/ EIIS Component Identifier: XFMR
4_/ EIIS System Identifier: EK; EIIS Component Identifier: BU

PI Unit 1 Main Generator connection:
PI Bus 345-1 (which was disconnected from grid)
PI Unit 2 Main Generator connection:
PI Bus 345-1 (which was disconnected from grid)
PI Bus 345-1 connections:
No grid connections
PI Unit #1 Main Generator, at overspeed and overvoltage conditions
PI Unit #2 Main Generator, at overspeed and overvoltage conditions
Offsite source 2R transformer
Offsite source CT-11 transformer via CT-1 transformer
PI Bus 345-2 connections:
Byron line
Offsite source 1R transformer via #10 transformer
Offsite source CT-12 transformer via #10 transformer
Safeguards Bus 15 (Unit 1) source was 1R transformer (Path 1-1)
Safeguards Bus 16 (Unit 1) source was CT-11 transformer (Path 1-2)
Safeguards Bus 25 (Unit 2) source was 2R transformer (Path 2-1)
Safeguards Bus 26 (Unit 2) source was CT-12 transformer (Path 2-2)

Note that the Emergency Response Computer Systems 5_/ (ERCS) provided partial event sequence data. Without the ERCS record, some of the timing of the sequences is unknown.

At this point in time PI Bus 345-1 and the PI main generators were running separated from the grid. Both turbines began to accelerate and peaked at 110% speed within 4 seconds. All rotating loads connected to PI Bus 345-1 or the main auxiliary transformers would have also accelerated. This included the reactor coolant pumps 6_/ (RCPs). With loss of load the generator output voltage increased approximately 10%. Unit 2 Emergency Response Computer System ERCS alarmed as the Nuclear Instrumentation System (NIS) power range indication reached 102.7%. Unit 2 reactor tripped on a positve rate signal. Unit 1 had four "first out" annunciations 7_/. Based on the available information, the reactor received a turbine trip/reactor trip signal initiated by a turbine overspeed condition. The turbine stop valves 8_/ closed and the turbine started to coast down in speed. The Byron 345 KV line was the source to 1R and CT-12 via Bus 345-2 and #10 Transformer.

Approximately 20 seconds after the reactors tripped, the frequency would have been less than 58.2 Hz, the low frequency setpoint for the RCP breakers; apparently the reactor coolant pumps tripped at this time. Both reactor coolant systems 9_/ began natural circulation. At about 25 seconds, apparently CT-12 source breaker 10_/ on Cooling Tower Bus CT-12 tripped on undervoltage. At about 30 seconds the main generators locked out. This would be

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5_/ EIIS System Identifier: ID
6_/ EIIS System Identifier: AB; EIIS Component Identifier: P
7_/ EIIS System Identifier: IB
8_/ EIIS System Identifier: TA; EIIS Component Identifier: V
9_/ EIIS System Identifier: AB
10_/ EIIS Component Identifier: BKR

the expected time delay after a reactor/turbine trip. The normal 4 KV buses transferred to 1 R (Unit 1) and 2R (Unit 2). Because 2R became de-energized, the Unit 2 normal busses also became de-energized. The main generators would have been below 56 Hz at this time. Following loss of power to the safeguards busses, the four safeguards diesel generators 11_/ auto-started and the load sequencers 12_/ connected the safeguards busses to their dedicated safeguards diesel generators (D1, D2, D5, and D6), the following indicates the significant equipment configurations:

Safeguards Bus 16 (Unit 1) auto transferred from CT-11 transformer to D2.
Safeguards Bus 25 (Unit 2) auto transferred from 2R transformer to D5.
Safeguards Bus 26 (Unit 2) auto transferred from CT-12 transformer to D6.
Safeguards Bus 15 (Unit 1) remained on 1R for approximately seven minutes before auto transfer to D1. Voltage on 1R varied at this time and apparently dipped low and long enough to cause a transfer.
12 Circ 13_/ Water Pump locked out.
Bus 27 and 121 Motor Driven Cooling Water pump 14_/ (fed by Bus 27) were de-energized for about 20 seconds before they were sequenced on to a DG powered bus. During the sequence delay, both diesel driven cooling water pumps started. By design this prevented the restart of 121 Motor Driven Cooling Water Pump.
21 Motor Driven Cooling Water Pump had a dead bus for a source.
11 Motor Driven Cooling Water Pump apparently remained running and

fully functional throughout the event. The lack of alarms
indicates it performed as expected.
The Low Cooling Water Pressure annunciator alarmed.
22 Diesel Cooling Water Pump and 12 Diesel Cooling Water Pump were
running about 22 seconds after the low pressure alarm.
11 Auxiliary Feedwater pump 15_/ (AFWP) started.
12 Auxiliary Feedwater Pump started.
21 Auxiliary Feedwater Pump started.
22 Auxiliary Feedwater Pump started.

Operators restored letdown 16_/ to regain pressurizer 17_/ level and pressure control and verified natural cooling at approximately 1500, and took control of cooldown and steam generator 18_/ levels by throttling of the auxiliary feedwater valves 19_/.

11_/ EIIS System Identifier: EK; EIIS Component Identifier: DG
12_/ EIIS System Identifier: ER
13_/ EIIS Component Identifier: P
14_/ EIIS System Identifier: BI; EIIS Component Identifier: P
15_/ EIIS System Identifier: BA; EIIS Component Identifier: P
16_/ EIIS System Identifier: CB
17_/ EIIS Component Identifier: PZR
18_/ EIIS System Identifier: R; EIIS Component Identifier: SG
19_/ EIIS System Identifier: BA; EIIS Component Identifier: V

A Notification of Unusual Event (NUE) was declared by the Shift Manager based on initiating condition EAL #20C, "Conditions that involve other than controlled shutdown." This decision was partially based on the belief that there was a steam line break in the Turbine Building 20_/ because of reports of steam filling the area. The steam was coming from 15B Feedwater Heater Tube Side Relief Valve 21_/ which opened and rotated 90 degrees, causing a leak at the threaded connection of the relief valve.

The Shift Manager directed the communications engineer to augment plant staff. The Emergency Response Organization was radio-paged and telephoned. Although the Technical Support Center and Emergency Offsite Facility were never formally activated, they were staffed and utilized for staff augmentation and communications. The performance of the ERO was judged to be effective.

During management of the event, loss of ERCS on Unit 1 required manual scanning of the Critical Safety Function Status Trees which is normally performed by the computer.

At approximately 1700 the operators manually closed the Main Steam Isolation Valves 22_/ (MSIVs) on both units; this was done in order to maintain the reactor coolant system temperature. Also, they began borating both units to place them at hot shutdown concentration with shutdown banks inserted.

Following consultation with the Technical Support Center, it was planned to restore 2R, re-establish the ring bus, and to obtain voltage support from the grid. Per standing operating procedure, 2R transformer was re-energized by transferring it to PI Bus 345-2 and, at approximately 1800, Unit 2 normal buses were being re-energized from 2R transformer. The substation voltage was at or below 330 KV several hours into the event. The Prairie Island plant manager requested voltage support from System Operations.

System Operations adjusted taps on system transformers and, at 1925, purchased additional power from the adjacent utilities, thus restoring voltage to the Byron line; this provided a stable offsite source, allowing transfer of safeguards busses back to an offsite source and restart of reactor coolant pumps. Since full functionality and redundancy of all safeguards equipment existed and the load sequencers would have automatically transferred any safeguards bus to the energized offsite source in the event of the failure of a diesel generator, priority was given to re-establishing forced circulation in the reactors. At 1953 the operators restarted a Unit 1 RCP and, at 2028, they restarted a Unit 2 RCP. Prairie Island Technical Specifications require that, above 350 degrees F, at least one reactor coolant pump be operating, except for a one hour allowed time with both pumps out-of-service. There is no specific limiting condition for operation action statement for this condition, so the general limiting condition for operation action statements in TS 3.0.C was in effect. The general action statement was not exceeded.

On Sunday, June 30, 1996, at 0135, the Blue Lake 345 KV line was restored. The diesel generators were sequentially loaded onto the grid and loaded for a period of time and then restored to standby condition while the

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20_/ EIIS System Identifier: NM
21_/ EIIS System Identifier: SJ; EIIS Component Identifier: RV
22_/ EIIS System Identifier: SB; EIIS Component Identifier: ISV

safeguard buses were loaded onto offsite sources. We remained in the NUE until 1035 on June 30 when the last safeguards diesel generator was tested and returned to standby condition.

The Red Rock line #1 was de-terminated at the Prairie Island substation. This allowed re-establishing the ring bus between Prairie Island Bus 345-1 and Bus 345-2.

Throughout the event, safety-related equipment performed as necessary to cope with this event.

The units were then brought back to power over the next two days. There were some non-safety related equipment problems during return to power operations (e.g., turbine EH 23_/ control problems on Unit 1 and the #9 bearings 24_/ for both turbines were slightly wiped, probably during the turbine overspeed condition).

Red Rock 345 KV line #2 was restored to the electrical grid on July 4 and line #1 was restored on July 8, 1996.

CAUSE OF THE EVENT

Severe weather with straight-line winds caused three out of four 345 KV transmission lines leading into the Prairie Island substation to fail.
The Blue Lake line had a downed phase while both Red Rock lines had several failed support structures.

ANALYSIS OF THE EVENT

All safeguards equipment performed as expected:
Reactor Protection
Reactor Trip Breakers
Safeguards Diesel Generator Starts
Bus Load Sequencers
Cooling Water Pump Starts
Auxiliary Feedwater Pump starts
Reactor Coolant Pump trips

Manual action was taken to control the event:
Control cooldown
Stop & throttle the Auxiliary Feedwater Pumps
Close Main Steam Isolation Valves
Restart Reactor Coolant Pumps
Restore electrical sources and configurations
Return Diesel Generators to normal standby condition

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23_/ EIIS System Identifier: TG
24_/ EIIS System Identifier: TA

Because of the proper functioning of the event mitigating equipment and the proper management of the event by operators, health and safety of the public was not affected.

Due to the entry into the general limiting conditions for operation action statements in TS 3.0.C, this event is reportable pursuant to 10 CFR 50.73(a)(2)(i)(A). Since there was an external condition (the wind storm) which posed a threat to the safety of the plant, this event is reportable pursuant to 10 CFR 50.73(a)(2)(iii). Due to manual and automatic actuations of the Engineered Safety Features as described above, this event is reportable pursuant to 10 CFR 50.73(a)(2)(iv).

CORRECTIVE ACTION

The Blue Lake line downed phase was restored. The Red Rock lines failed support structures were repaired.

Both short term and long term adjustments are being made to the agreements between the plant and System Operations to provide voltage support during trip recovery.

The 15B Feedwater Heater relief valve which opened, rotated, and thereby developed a leak was removed, repaired, and retested. The leaking inlet nipple was replaced. The discharge line to the drain funnel was secured with the existing pilot holes provided for that purpose.

To provide increased assurance that ERCS will be available following a loss of power event, several actions are being considered; these include hardware, software, and procedural changes.

The turbine EH control system was repaired.

The turbine bearings that were damaged when the turbine overspeed condition caused some increased vibration. This was reduced on Unit 1 by adding balance weights to the rotor. Unit 2 vibration was still at an acceptable level. Plans are to repair the damaged bearings on both units during scheduled outages.

FAILED COMPONENT IDENTIFICATION

One 345 KV phase conductor was blown off of its support structure and thirteen wooden support structures were downed by high winds.

PREVIOUS SIMILAR EVENTS

A loss of offsite power event was discussed in the Reportable Occurrence report 80-20.

Figure "SOURCES TO UNIT 1 SAFEGUARDS BUSSES" omitted.

Figure "SOURCES TO UNIT 2 SAFEGUARDS BUSSES" omitted.

NSP Northern States Power Company

Prairie Island Nuclear Generating Plant
1717 Wakonade, Dr. East
Welch, Minnesota 55089

July 29, 1996

10 CFR Part 50
Section 50.73

U S Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Loss of Offsite Power to Unit 2 and Degraded Offsite
Power to Unit 1 Followed by Reactor Trips of Both Units

The Licensee Event Report for this occurrence is attached. In the report, we made no new NRC commitments.

This event was reported via the Emergency Notification System in accordance with 10 CFR Part 50, Section 50.72, on June 29, 1996. Please contact us if you require additional information related to this event.

Michael D Wadley
Plant Manager
Prairie Island Nuclear Generating Plant

c: Regional Administrator - Region III, NRC
NRR Project Manager, NRC
Senior Resident Inspector, NRC
Kris Sanda, State of Minnesota

Attachment

*** END OF DOCUMENT ***